

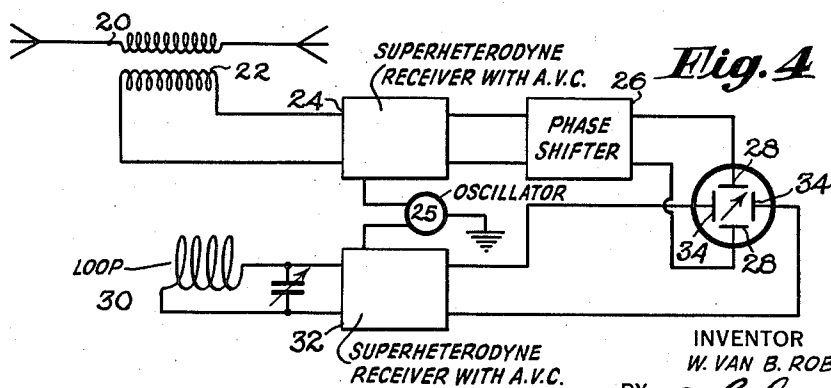
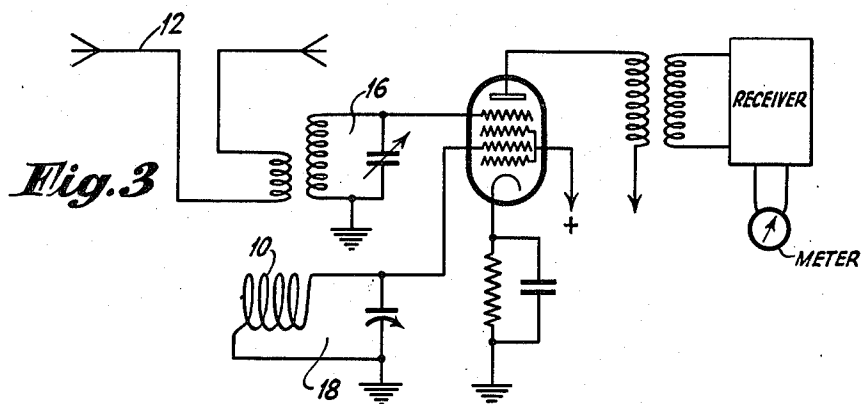
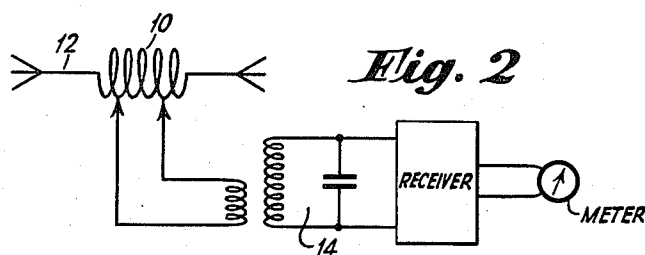
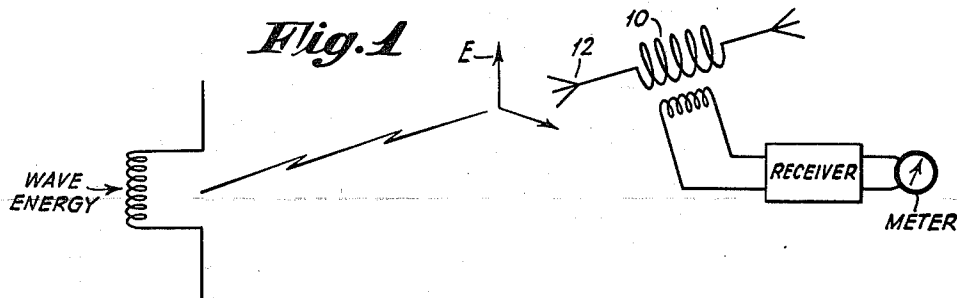
May 28, 1940.

W. VAN B. ROBERTS

2,202,400

DIRECTIVE SIGNALING

Filed May 6, 1937



INVENTOR
W. VAN B. ROBERTS

BY *H.S. Brown*
ATTORNEY

UNITED STATES PATENT OFFICE

2,202,400

DIRECTIVE SIGNALING

Walter van B. Roberts, Princeton, N. J., assignor
to Radio Corporation of America, a corpora-
tion of Delaware

Application May 6, 1937, Serial No. 141,024

2 Claims. (Cl. 250—11)

This application concerns a new method of the magnetic field indicated by vector H be in-
and means for determining the tangent plane to
a plane polarized wave front.

In my copending application Serial #141,023,
filed May 6, 1937, there is described a method of
direction finding employing a rotary polarized
wave and a simple loop or open antenna. Ac-
cording to the present invention a directional
receiving antenna system is disclosed that gives
zero pickup of voltage from a plane polarized
wave only when its axis coincides with the direc-
tion of propagation of the wave.

In describing my invention reference will be
made to the attached drawing wherein;

Figure 1 illustrates schematically a source of
plane polarized wave energy, an antenna system
of my invention and the relation of the antenna
and the wave energy field components; while

Figures 2, 3, and 4 illustrate modified forms of
the antenna system and receiver of the present
invention.

In my novel system an antenna structure is
employed that consists of two portions, one por-
tion being a loop 10 having its axis either mounted
on gimbals or fixed parallel to the line of flight
of an aeroplane and the other an open antenna
12 preferably concentric with the loop and in
any case having its axis parallel to the loop axis.
Figures 1 and 2 show such an antenna where
the lengths of the open portions are so chosen
that assuming vertical polarization the pickup
of the open portion for a given vertical deviation
of the antenna axes from the line of propaga-
tion is the same as the pickup of the loop por-
tion for a horizontal deviation of the same
amount. The entire loop system may be so di-
mensioned as to the loop and open portions and
the end capacities of the open portions that the
system is resonant to the desired signal frequency
or the system may be tuned by a variable con-
denser or coupled to an auxiliary tuned circuit
14 as shown in Figure 2 in the drawing. In
any case the total voltage picked up will be zero
only when the axes of the component portions
of the antenna coincide with the direction of
wave propagation while in case the axes deviate
from this direction the total voltage picked up
will be proportional to the sine of the angle of
deviation and will differ in phase only in accord-
ance with the direction of this deviation. This
will be apparent to one skilled in the art because
only when the axis of 12 and 10 coincides with
the direction of the wave travel will the electrical
field of the wave indicated by vector E in Figure
1 be ineffective to produce a voltage in 12 and

effective to produce a voltage in 10. Thus if the
pilot wishes to fly directly toward a ground sta-
tion as in the case of blind landing he needs
only to steer the plane so that its direction of
flight coincides with the axis of the antenna sys-
tem when the latter is in the position of zero
pickup.

In a modification of the invention the loop
and open antenna portions may deliver their
voltages separately to the receiver. In Figure 3
this is accomplished by applying the voltage de-
rived from the open portion to one grid of a
dual control grid type of vacuum tube while the
loop voltage is applied to the other control grid.
The axes of the two antenna portions are fixed
parallel to each other and if not arranged con-
centrically at least the two portions are arranged
to be not more than a small fraction of a wave
length different in their respective distances from
the ground station so as to avoid any appreciable
shift in their relative voltage phases. In Figure
3 it is not necessary to construct the two an-
tennae for equal pickup at equal vertical and
horizontal angles of deviation as the coupling
between the open antenna and its associated
tuned circuit may be adjusted to equalize the
effects of the two antenna voltages upon the
plate current of the tube. In this case separate
tuning means 16 and 18 may be used.

In the modification shown in Figure 4 a plane
polarized wave from any source is again used
to take bearings on. The system of Figure 4 com-
prises a linear aerial 20 which may be of the
dipole type, coupled by a tuned circuit 22 to a
superheterodyne receiver 24 having automatic
volume control features. The output of super-
heterodyne receiver 24 is connected by means
of a phase shifter 26 the purpose of which will
be described later, to a pair of plates 28 of a
cathode ray tube. A loop aerial 30 is connected
to the input of a second heterodyne receiver 32
having automatic volume control features and
being coupled at its output to the plates 34 of
the cathode ray tube. The vertical aerial 20 is
mounted preferably along the axis of the plane
while the loop aerial 30 is mounted with its plane
at right angles to the line the plane normally
follows. In operation the voltages picked up by
the loop aerial 30 and vertical aerial 20 are re-
duced by heterodyne receivers 32 and 24 and
common local oscillator 25 to intermediate fre-
quency wave energy on voltages which is im-
pressed on the plates of the cathode ray tube.
When no energy is picked up by either aerial the

cathode ray will fall on the center of the target. Under these conditions it may be assumed that the ship is moving exactly toward the station sending out the plane polarized wave. If the ship deviates upwards the vertical aerial 20 picks up voltage which acts through the receiver 24 and phase shifter 26 to influence the path of the ray in a vertical direction so that it makes a vertical trace on the cathode ray tube target.

10 The same effect happens when the plane's path is downward so that the vertical aerial again picks up voltage. When the ship deviates both upwards and sideways, that is, in a horizontal plane, voltage is picked up by the loop and by the vertical. These voltages, acting through the receivers 24 and 32, are set up across both pairs of plates and the trace inclines at an angle which is determined by the ratio of the angles of deviation of the plane in the horizontal and in the vertical and hence indicates clock position of the axis of the plane with respect to the line between the plane and the transmitter. During normal operation, the pilot of the plane so steers the same that there is no horizontal deviation but there is a vertical deviation as the pilot is flying in a horizontal plane at some wave height above ground indicated by his barometer. When he passes the field boundary the ship or the transmitter station is located, which boundary is indicated by local markers. He turns the nose of the plane down until the vertical deviation is zero and then holds the spot or the cathode ray on the center of the target until he reaches ground. As a check he may read the angle of descent on other instruments.

The line of direction is indicated, as given above, and sense of direction may be determined by orienting the plane and noting the direction which the cathode ray deviates. The phase shifting means 26 may be of any nature such as for example, as illustrated in my United States application #69,105 filed March 6, 1936, or of a more simplified type. The purpose of the phase shifting means 26 is to permit proper polarity and phase relation between the voltages on the plates 20 and 34 to obtain correct indications of the plane's deviation from its correct path. If it deviates in the wrong direction then the pilot will note that he is flying away from the trans-

mitter station instead of towards it. It will be understood that in addition to being given suitable polarity to make the angle of inclination of the oscilloscope trace correspond to the sense of deviation in a desired fashion, the relative phase of the voltages on the plates is preferably adjusted to produce a linear trace, that is, the phase difference is preferably either zero or 180°.

I claim:

1. In a directional receiving system, a linear absorption member responsive only to wave energy when a line through its length deviates from the line of direction of propagation of said wave energy, a second member arranged in a plane perpendicular to said linear member and responsive only to voltage in said wave energy when its plane deviates from a position at right angles to the line of direction of said propagated wave energy, a cathode ray tube including a target and pairs of deflecting plates and amplifying means coupling for applying high frequency energy from each of said members to a different pair of deflecting plates, a phase shifting means between one of said amplifying means and the deflecting plates associated therewith, said last means being so adjusted that the energy applied to each of said pairs of plates is in phase whereby a linear indication is obtained.

2. A directional receiving system for aircraft comprising a linear antenna disposed longitudinally of said craft and responsive only to wave energy when a line through the length deviates from the line of direction of propagation of said wave energy, a loop antenna disposed in a plane transverse to said craft and responsive only to wave energy when its plane deviates from a position at right angles to the line of propagation of said wave energy, a cathode ray tube including a target and pairs of deflecting plates, means including amplifiers for applying high frequency energy picked up by each of said antennas to a different pair of deflecting plates and phase shifting means between one of said amplifying means and the deflecting plates associated therewith, said last means being so adjusted that the energy applied to each of said pairs of plates is in phase whereby a linear indication is always obtained.

WALTER VAN B. ROBERTS.